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Tank Gunnery: Transfer of Training From TopGun to the Conduct-of-Fire Trainer

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May 1990

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This research examined the effect of TopGun training on main gun M60A3 tank gunnery performance as measured on the Conduct-of-Fire Trainer (COFT). Three groups of 16 Reserve Component (RC) soldiers were compared using a transfer-of-training design. Firing under auxiliary sighting conditions, the groups differed on the number of TopGun training sessions (0, 1, or 3) they had before completing a testing session on COFT. Results showed that gunnery speed and accuracy on stationary and moving targets improved during TopGun training and that prior training on TopGun improved subsequent performance on COFT in terms of increased accuracy on stationary target engagements. TopGun performance was also found to be a reliable predictor of COFT performance, with greater correlations found for speed than for accuracy. This report outlines a TopGun-based training strategy for increasing the probability of positive transfer to moving targets, as well as to stationary targets, and for enhancing the overall payoff obtained from TopGun training within the RC.

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FOREWORD

This report examines the effect of TopGun-based training on tank gunnery performance of Reserve Component (RC) armor crewmen. Results suggest that training with TopGun can enhance the proficiency of tank gunnery skills. Given these positive findings and TopGun's standalone design and relative low cost, the potential exists for TopGun to support effective RC home-station gunnery training, and thereby, to help overcome time, equipment, and range constraints in the RC training environment.

This research was conducted by the Training Technology Field Activity--Gowen Field (TTFA-GF), whose mission is to improve the effectiveness and efficiency of RC training through use of the latest in training technology. The research task supporting this mission is entitled "Application of Technology to Meet RC Training Needs" and is organized under the Training for Combat Effectiveness program area.

The National Guard Bureau (NGB), Office of the Chief, Army Reserve (OCAR), and U.S. Army Training and Doctrine Command (TRADOC) sponsored this project under a Memorandum of Understanding, signed 12 June 1985, establishing the TTFA-GF. Project results have been presented to Chief, Training Support Branch, NGB; Chief, Training Division, OCAR; and Director, Training Development and Analysis Directorate (TDAD), TRADOC.

Edgar M. Johnson

EDGAR M. JOHNSON
Technical Director

TANK GUNNERY: TRANSFER OF TRAINING FROM TOPGUN TO THE CONDUCT-OF-FIRE TRAINER

EXECUTIVE SUMMARY

Requirement:

Determine effectiveness of TopGun-based training for enhancing Reserve Component (RC) tank gunnery skills.

Procedure:

The performance of three groups of 16 RC soldiers was compared using a transfer-of-training design. Firing under auxiliary sighting conditions, groups differed on the number of TopGun training sessions (0, 1, or 3) performed prior to completing a single testing session on the Conduct-of-Fire Trainer (COFT). TopGun and COFT sessions each consisted of 40 single-target engagements containing an equal proportion of stationary and moving targets presented at short and long distances. Soldier performance on each device was measured for both speed and accuracy.

Findings:

Results revealed that gunnery speed and accuracy on stationary and moving targets improved during TopGun training and that prior training on TopGun enhanced subsequent performance on COFT in terms of increased accuracy on stationary target engagements. TopGun performance was also found to be a reliable predictor of COFT performance, with greater correlations found for speed than for accuracy.

Utilization of Findings:

The findings of this research suggest that TopGun can be used to (a) support effective training of tank gunnery skills needed for the accurate main gun engagement of stationary targets from a stationary M60A3 tank, and (b) predict gunnery speed and accuracy on COFT. These initial positive findings, coupled with TopGun's standalone design and relative low cost, underscore the potential for TopGun to support effective home-station training of RC armor crewmen, and thereby, to help overcome time, equipment, and range constraints present within the RC training environment. Further research is needed to evaluate the potential effectiveness of TopGun-based training on moving target engagement proficiency and to identify RC-specific training strategies for achieving maximum payoff from resources expended.

TANK GUNNERY: TRANSFER OF TRAINING FROM TOPGUN TO THE CONDUCT-OF-FIRE TRAINER

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TANK GUNNERY: TRANSFER OF TRAINING FROM TOPGUN TO THE CONDUCT-OF-FIRE TRAINER

Background

Required tank gunnery proficiency levels are difficult to attain and sustain because of high ammunition costs and limited availability of equipment and live-fire ranges (U.S. Armor School, 1981). This is especially true in Reserve Component (RC) units where the negative impact of equipment and range constraints is magnified by restrictions on available training time, i.e., about one fifth of that available to Active Component (AC) units (U.S. Army Training Board, 1987). In addition, most of this time is spent on Inactive Duty Training (IDT) at home-station armories or reserve centers that are geographically separated from range or maneuver areas (Eisley & Viner, 1989).

To enhance the capability of training tank gunnery at home station, and thereby compensate for difficulties known to exist within the RC training environment, several training devices have been developed. One such device is TopGun; a low-cost, standalone, part-task, tank gunnery trainer developed jointly by the Defense Advanced Research Projects Agency (DARPA) and the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI).

Depicted in Figure 1, TopGun consists of an enclosed gunner's station equipped with the necessary switches and controls used in live-fire gunnery engagements, a Cathode-Ray Tube (CRT) designed to simulate the gunner's primary and auxiliary sight, and a computer-controlled audio system to provide battle sounds and the fire commands normally given by the Tank Commander (TC). The device also features a software-based performance measurement system (PMS) that enables flexible target programming as well as on- and off-line scoring of desired engagement scenarios [see NKH (1989) for a complete description of TopGun and its capabilities].

Given the device's functional design and relative low cost, TopGun has the potential of supporting cost-effective, home-station, tank gunnery training for RC armor crewmen. Initial research examining the validity of this claim (Turnage & Bliss, 1989) has shown that prior training with TopGun in combination with the Videodisc Interactive Gunnery Simulator (VIGS) improves subsequent tank gunnery performance, as measured on the Conduct-of-Fire Trainer (COFT). To date, however, no empirical data have been reported to show the effectiveness, or ineffectiveness, of prior training on TopGun alone. The present experiment was conducted to provide these data.

The tank gunnery performance of three groups was compared using a transfer-of-training design. Firing under auxiliary sighting conditions, groups differed on the number of training sessions (0, 1, or 3) performed on the M60A3 tank version of TopGun prior to completing a single testing session on the M60A3

tank version of COFT. The selection of COFT as the criterion device on which to measure TopGun transfer was based on Graham's (1986) results showing that gunnery performance on COFT is reliable, and the findings of others (e.g., Hughes, Butler, Sterling, & Berglund, 1987; Martellaro, Thorne, Bryant, & Pierce, 1985), suggesting that prior COFT-based training can improve subsequent live-fire tank gunnery performance. Thus, to the degree that prior TopGun training is found to enhance (transfer positively to) subsequent COFT performance, the potential for effective tank gunnery training via TopGun will have been demonstrated.

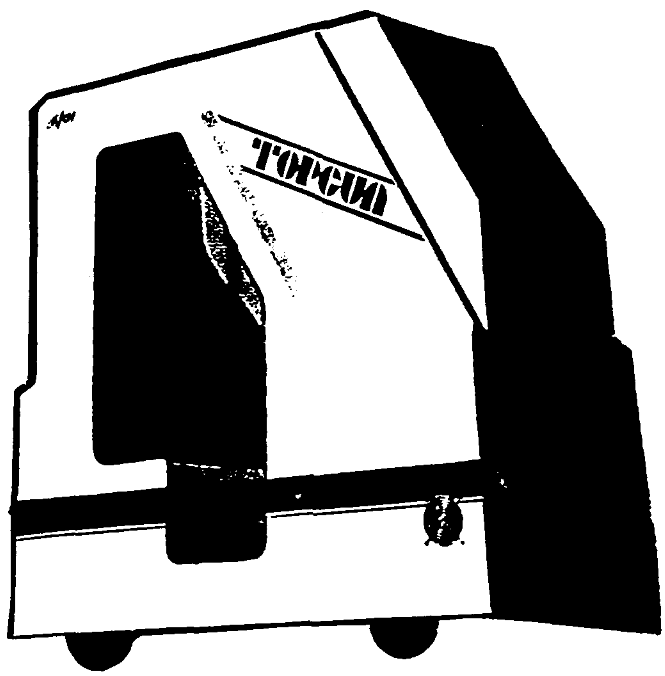

Figure 1. External view of TopGun.

To this end, the present research was designed to answer the following questions:

1. Does gunnery performance improve during TopGun training?
2. Does TopGun training transfer to COFT?
3. How much TopGun training is needed for effective transfer?
4. Can TopGun performance be used to predict COFT performance?
5. How do target characteristics affect performance on each device?

Answers to these questions will provide the RC with the kind of specific information needed to evaluate potential TopGun-based training benefits, determine if and how the device should be used, and decide whether future development and/or fielding of the device is justified.

Method

Subjects

Forty-eight, male, enlisted Idaho Army National Guard (IDARNG) soldiers under age 35 participated in the experiment. Half of these soldiers held the 19E (Armor Crewman) Military Occupational Specialty (MOS) with a duty position of either driver or loader, and therefore, had only limited tank gunnery experience. The other half consisted of soldiers with non-19E MOSs and no tank gunnery experience.

Design

Sixteen soldiers were assigned randomly to each of three groups (one control and two experimental) under the constraint that each group contain the same number of soldiers with 19E and non-19E MOSs. As shown in Figure 2, all groups received one session of COFT testing preceded by different amounts of TopGun training. The two experimental groups (E1 and E3) received 1 and 3 prior sessions of TopGun training, respectively, whereas the control (C) group received no TopGun training prior to COFT testing.

TopGun and COFT sessions each consisted of 40 single-target engagements containing an equal proportion of stationary and moving targets presented at short and long distances. Overall, TopGun targets were programed to be as similar as possible to COFT targets in order to enhance the possibility of finding positive transfer of training from one device to the other. Close targets varied from 1200-1500 m on TopGun and from 900-1500 m on COFT; distant targets varied from 1700-2300 m on TopGun and from 1600-2300 m (except for one outlier target located at 790 m) on COFT. Moving target speed varied from 10-25 mph on TopGun and from 10-35 mph on COFT. TopGun targets were exposed for 30 s, whereas COFT targets were exposed from 32-38 s.

Group	Sessions: TopGun Training			COFT Testing
E3	1	2	3	1
E1	-	-	1	1
C	-	-	-	1

Figure 2. Training and testing sequence for each treatment group.

Targets were presented in 4 blocks, i.e., close/stationary, distant/stationary, close/moving, distant/moving, of 10 targets each. For COFT, these target blocks corresponded to M60A3 Matrix Exercises 71111, 72111, 71311, and 72311 (General Electric Company, 1987). Four different blocking orders were used to

control for possible sequence effects. Order presentation was counterbalanced such that four soldiers (2 19E MOS; 2 non-19E MOS) in each group received one of the four blocking orders. Soldiers received the same blocking order on both devices with the target presentation sequence randomized within blocks to discourage target anticipation. Soldiers who received three TopGun sessions received the same blocking order each session with target presentation randomized in a different sequence across sessions.

Procedure

Soldiers in the TopGun training groups were given 15 min of device familiarization that included a warm-up session on 10 practice targets preceded by verbal instructions on (a) use of the device's control handles and sight reticle, and (b) fire control adjustment procedures for moving target engagements under auxiliary sighting conditions (Department of the Army, 1986). This was followed by either 1 or 3 sessions of TopGun training during which soldiers engaged targets using the auxiliary (M105D Telescope) sight. In doing so, soldiers were required to manually estimate and apply the appropriate elevation and lead (if target was moving) to the sight reticle in order to record a hit using armor-piercing discarding sabot-tracer rounds (APDS-T). TopGun was programed to lay the main gun automatically near the target (i.e., +/- 5 m in elevation and azimuth) upon its appearance and provide the appropriate fire command with embedded tank-to-target distance information. During training, feedback regarding individual shot trajectory and location was shown directly on the CRT. Soldiers were allowed to fire as many rounds as possible during the target presentation interval until the target was hit or disappeared from the screen. Each TopGun session took about 20 min excluding 5-min intersession rest periods for soldiers in the 3-session group.

COFT testing included 20 min of device familiarization during which soldiers received a safety briefing, general operating procedures, and the opportunity to fire at four practice targets. Soldiers then engaged 40 test targets similar to those presented on TopGun. COFT testing was conducted by two military COFT instructor/operators (I/Os) who played the part of the tank commander. Each I/O tested roughly the same number of soldiers in each group. During testing, the I/O laid the main gun near the target, furnished the appropriate fire command with embedded tank-to-target distance information, and recorded gunner performance. The COFT testing session lasted about 50 min. The interval between TopGun training and COFT testing was held to 15 min in order to minimize forgetting (Wells & Hagman, 1989).

Dependent Variables

Soldier performance on TopGun and COFT was measured for both speed and accuracy. Accuracy was defined as the number of first-round hits (i.e., rounds impacting within the 100% target kill zone) recorded in each block of 10 targets. Speed was defined as

the time from initial target appearance to the time of a first-round hit and was averaged across all hits within a block. Secondary performance measures were also recorded. For accuracy, these included aiming error (i.e., distance from point of aim to target center of mass--applied to stationary targets only), and firing efficiency (i.e., number of total hits recorded within a target block divided by the number of rounds fired). For speed, secondary performance measures included average hit time, regardless of the round on which the hit occurred, and opening time (i.e., first-round firing time regardless of outcome).

"Dispersion misses" (i.e., misses added by COFT to simulate ammunition variability) were examined to determine whether they varied randomly or as a function of treatment condition. In addition, because only APDS-T rounds were fired, COFT "system errors" resulting from targets calling for high-explosive antitank-tracer (HEAT-T) or coaxial machinegun engagements were ignored.

Results

Similar results were obtained for primary and secondary performance measures. Thus, only those for the primary measures of accuracy (i.e., number of first-round hits) and speed (i.e., time to first-round hit) are reported. Dispersion misses did not vary across treatment conditions.

<u>TopGun Training</u>

To answer the first question "Does gunnery performance improve during TopGun training?" a Sessions (1-3) x Target Distance (close, distant) x Target Movement (stationary, moving) repeated measures analysis of variance (ANOVA) was performed on the speed and accuracy scores of soldiers who received three sessions of TopGun training, i.e., Group E3. A multivariate analysis of variance (MANOVA) preceded univariate analyses to control for the possibility of Type-I error occurrence when more than one dependent variable is analyzed. Unless stated otherwise, the rejection region for all analyses was $p<.05$.

Soldiers' performance improved across the three sessions of TopGun training, as revealed by a significant multivariate sessions effect, $F(4, 12) = 15.2$, and significant univariate sessions effects for both accuracy, $F(1, 15) = 11.7$, and speed, $F(1, 15) = 36.4$. Session means, depicted in Table 1, show an increase in the number of stationary and moving targets hit and a decrease in the time required to hit them.

The improvement in performance, however, was not uniform across all target types. A significant Sessions (1-3) x Target Movement (stationary, moving) interaction was found with both the multivariate analysis, $F(4, 12) = 3.8$, and the univariate analyses for accuracy, $F(1, 15) = 6.0$, and speed $F(1, 15) = 6.0$. Accuracy increased more for moving than for stationary targets across

sessions, probably because performance on stationary targets, unlike that on moving targets, started out high (i.e., 9.1 hits) and thereafter was artificially restricted by the 10-target maximum ceiling. Speed also increased more for moving targets than for stationary targets. This difference was probably the result of soldiers starting out faster on stationary targets than on moving targets and having less opportunity to improve their speed across sessions (Boldovici, 1987).

Table 1

Gunnery Performance During TopGun Training

		Session		
Target	Group	1	2	3
		Accuracy		
All	E3	7.1	7.4	7.9
	E1	6.8		
Stationary	E3	9.1	9.2	9.5
	E1	8.6		
Moving	E3	5.1	5.7	6.4
	E1	4.9		
		Speed		
All	E3	5.8	5.1	4.6
	E1	6.0		
Stationary	E3	5.4	4.8	4.4
	E1	5.3		
Moving	E3	6.3	5.5	4.8
	E1	6.6		

Note. Accuracy scores refer to the average number of first-round hits recorded for each block of ten targets presented. Speed scores refer to the average number of seconds required to achieve a first-round hit.

COFT Testing

To answer the second question "Does TopGun training transfer to COFT?" separate Group (E3, E1, C) x MOS (19E, non-19E) x Blocking Order (1-4) x Target Distance (close, distant) x Target Movement (stationary, moving) split-plot ANOVAs, with repeated measures on target distance and movement, were performed on COFT speed and accuracy scores. The two degrees of freedom associated with the group factor were also partitioned into two orthogonal

planned comparisons, denoted as Group(1) and Group(2). Group(1) compared control group performance with that of the average performance of the two experimental groups and was designed to determine whether transfer occurred from TopGun to COFT. Group(2) compared the performance of the experimental group with one TopGun session (i.e., E1) with that of the experimental group with three TopGun sessions (i.e., E3) and was designed to determine whether added training on TopGun produced additional transfer to COFT.

Initially, both accuracy and speed scores were entered simultaneously into a doubly multivariate MANOVA (Norusis, 1986) with the same five factors noted above. A significant Group(1) x Target Movement interaction was found with the full MANOVA model, $\underline{F}(2, 23) = 3.61$. Univariate tests on the accuracy and speed measures for this interaction term showed only the accuracy measure to be significant, $\underline{F}(1, 24) = 7.53$. Analysis of simple effects showed a significant Group(1) effect for stationary targets, $\underline{F}(1, 24) = 12.47$, but not for moving targets. Thus, the experimental groups that received TopGun training prior to COFT testing displayed better accuracy on COFT than did the control group, but only on stationary targets.

Simple effect analyses restricted to stationary targets showed a significant Group(1) x Distance interaction on accuracy, $\underline{F}(1, 24) = 4.47$. As shown in Figure 3, experimental group soldiers with prior TopGun training scored more hits on distant targets, but about the same number of hits on close targets, as control group soldiers with no prior TopGun training. Again, ceiling effects were probably operating selectively on close targets to produce the obtained interaction.

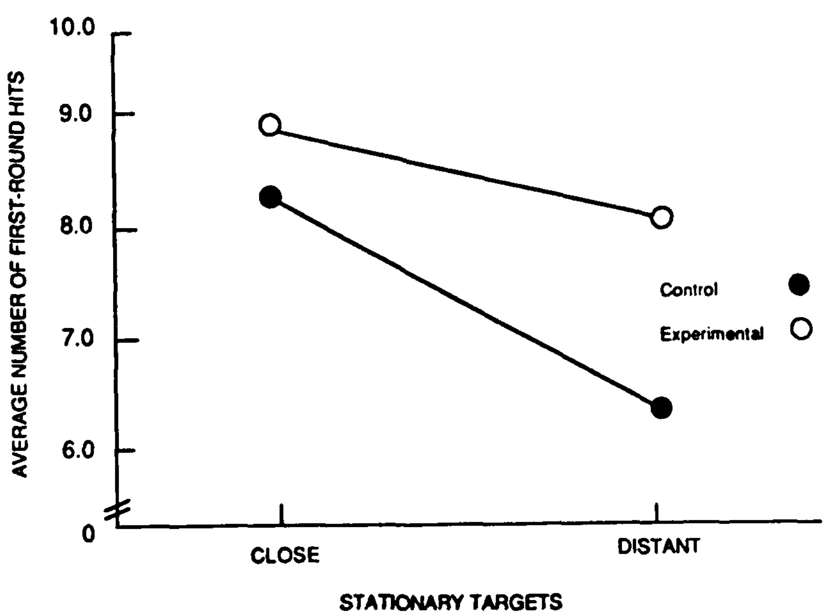

Figure 3. COFT performance on stationary targets as a function of prior TopGun training.

The third question "How much TopGun training is needed for effective transfer?" was addressed by comparing the COFT-based, stationary target accuracy scores of Groups E3 and E1 using the Group(2) orthogonal comparison mentioned above. This comparison was nonsignificant, revealing that transfer was rapid and required only a single TopGun training session to develop for the kind of stationary targets presented here. Increasing the number of training sessions from one to three produced no corresponding increment in transfer, probably because of performance ceiling effects mentioned earlier.

Relationship Between TopGun and COFT Performance

The fourth question "Can TopGun performance be used to predict COFT performance?" was answered by computing the correlation between corresponding measures of TopGun and COFT performance. In order to interpret the relative sizes of these correlations, within-device reliability coefficients were first calculated separately for TopGun and COFT performance. They are shown in Table 2. Each is based on the intercorrelation between separate performance measures for each type of target. For both TopGun and COFT, the correlation was higher for speed than for accuracy and resulted in the maximum possible between-device correlations shown in the far right column of Table 2.

Table 2

Correlations for TopGun and COFT Performance Measures

Performance Measure	Within-Device Reliability		Actual Correlation	Maximum Correlation
	TopGun	COFT		
Accuracy	.60	.42	.30*	.50
Speed	.87	.86	.66**	.87

Note. n = 32. Maximum correlation refers to the upper limit possible given the within-device reliabilities listed. Reliability coefficients are Cronbach's Alpha. They were calculated by applying the Spearman-Brown formula to the average intercorrelation between four performance measures, one for each target type.
*$p<.05$, one tailed.
**$p<.001$, one tailed.

The actual between-device performance correlations, also shown in Table 2, were statistically significant for both speed and accuracy. The speed correlation was larger, however,

indicating that COFT gunnery speed can be predicted more accurately than COFT gunnery accuracy on the basis of corresponding TopGun scores. This difference would be expected, given the results of the within-device reliability analyses.

Target Characteristics

In answer to the last question, target type was found to influence the speed and accuracy of gunnery performance demonstrated on both TopGun and COFT. As shown in Figure 4, the performance pattern obtained for engagement accuracy was similar on each device. Distant targets were more difficult to hit than close targets; moving targets were more difficult to hit than stationary targets. The difference in relative magnitude of the F-ratios, and proportion of variance accounted for, obtained for target movement and distance factors shown in Table 3 revealed that movement had a greater effect than distance on the ability of soldiers to record a first-round hit on both TopGun and COFT.

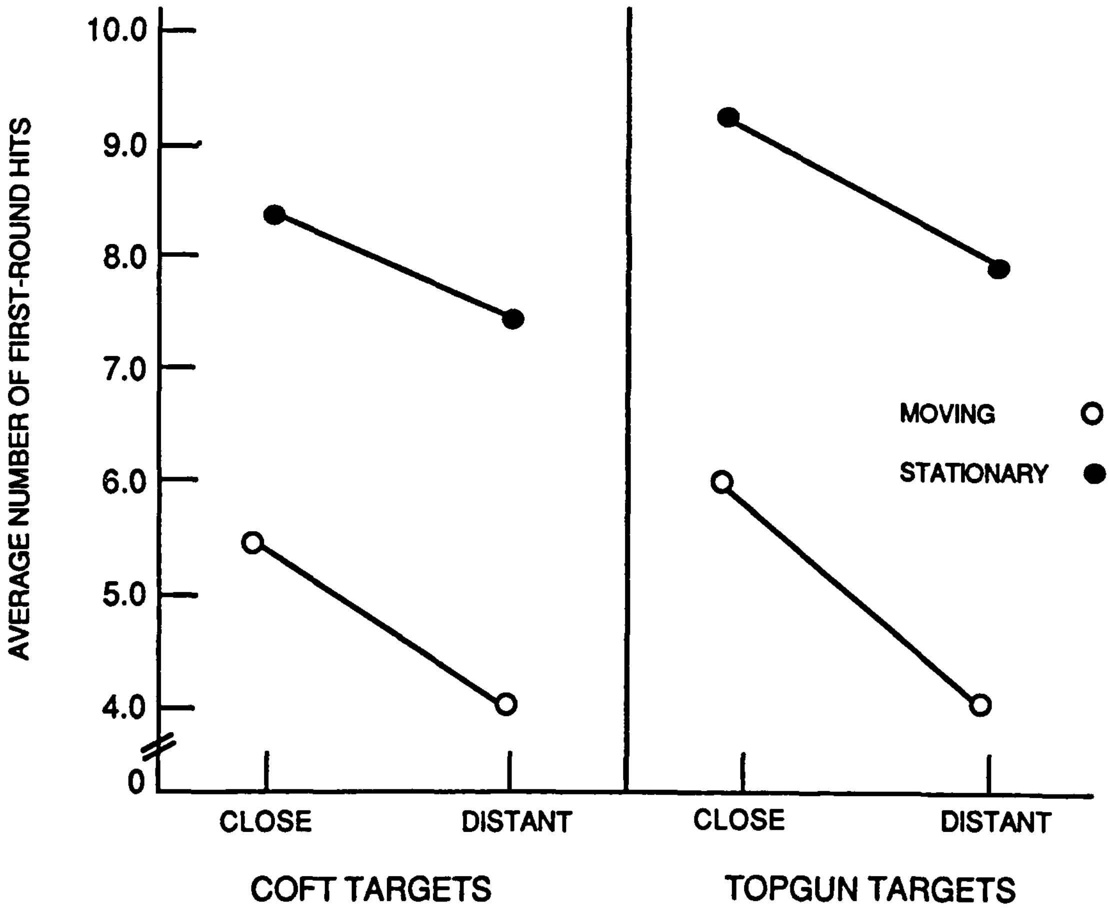

Figure 4. First-round-hit scores obtained on TopGun and COFT for each target type.

Table 3

F-Ratios for Target Factors

Target Factors	Accuracy		Speed	
		TopGun		
Distance	57.4*	(.09)	141.3*	(.42)
Movement	203.1*	(.59)	26.8*	(.15)
Distance x Movement	2.4	(.01)	.1	(.00)
		COFT		
Distance	40.5*	(.08)	15.7*	(.04)
Movement	222.8*	(.50)	187.3*	(.34)
Distance x Movement	1.4	(.00)	39.7*	(.18)

Note. The univariate *F*-ratios are from the full-rank model that included five independent variables and all interaction terms. TopGun *F*-ratios are based on 32 soldiers in the experimental groups and have 1 and 16 degrees of freedom. COFT *F*-ratios are based on all 48 soldiers tested and have 1 and 24 degrees of freedom. The numbers in parentheses represent the proportion of within-target variance accounted for by the target factors. Estimates of variance components were made according to formulas derived from expected mean squares, and then compared to the total within target variance composed of the sum of three target factor components and three error variance components (see Hart & Bradshaw, 1981; Winer, 1971).
*$p<.001$.

The speed of gunnery performance followed a slightly different pattern on the two devices. As shown in Figure 5, targets that were moving or distant generally took longer to hit than targets that were stationary or close. As indicated in Table 3, the relative *F*-ratio magnitude, and proportion of accounted-for variance, suggest that, at least on COFT, target movement had a greater effect than target distance on the time taken to achieve a first-round hit. Unlike TopGun speed scores, COFT speed scores produced a significant Distance x Movement interaction which resulted from the relatively slow speed of first-round hits on close, moving targets. Further review of the specific target scenarios presented on COFT revealed that several of the close targets were partially hidden from view when initially presented. Thus, soldiers may have held their fire until these targets became more visible.

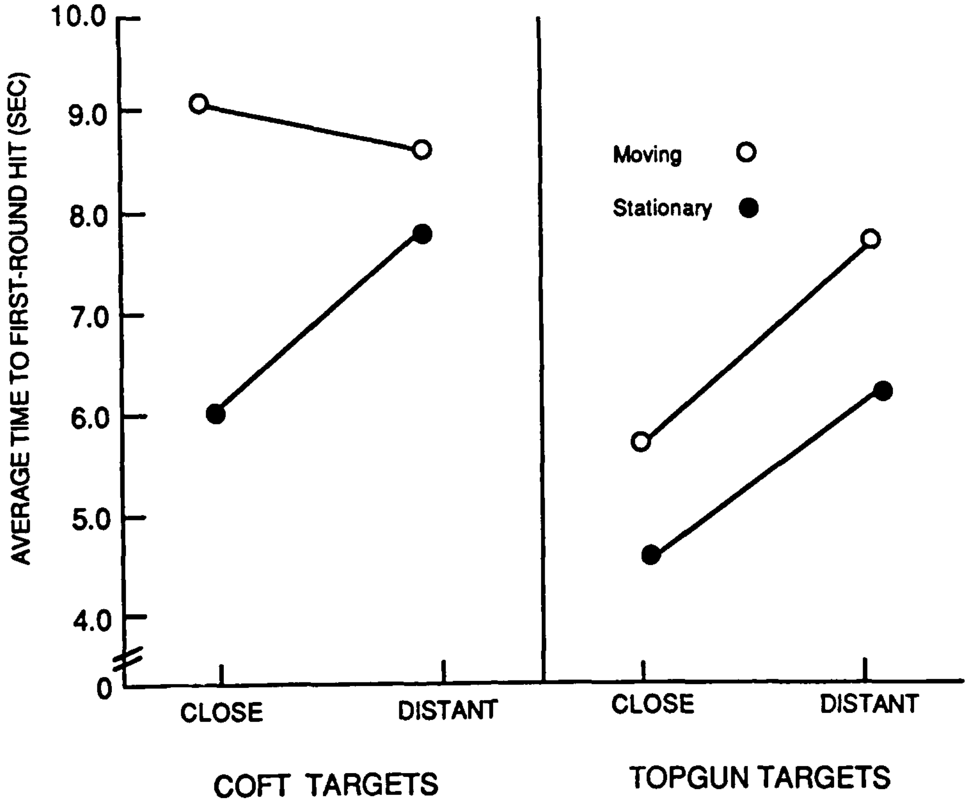

Figure 5. Time-to-first-round-hit scores obtained on TopGun and COFT for each target type.

Discussion

This research has shown that (a) gunnery speed and accuracy scores on stationary and moving targets improve during TopGun training, (b) prior training on TopGun enhances subsequent performance on COFT in terms of increased accuracy on stationary targets, (c) COFT performance can be predicted on the basis of TopGun performance, (d) transfer from TopGun to COFT is target specific, i.e., improved stationary target proficiency did not ensure improved moving target proficiency, (e) moving targets are more difficult to engage than stationary targets, and (f) distant targets are more difficult to engage than close targets.

Conservatively speaking, the above findings apply only to the conditions under which they were discovered [i.e., M60A3 degraded mode tank gunnery against single stationary and moving targets from a defensive (stationary) position using the ADPS portion of the auxiliary sight]. For example, a moving target may only be more difficult to hit than a stationary target when one's own tank is stationary (Hoffman, 1989). Nevertheless, the present finding of positive transfer, along with TopGun's standalone design and relative low cost, combine to underscore the device's potential to support effective home-station tank gunnery training for RC armor crewmen. In doing so, use of TopGun could help to overcome time, equipment, and range constraints present within the general RC training environment.

To increase TopGun's home-station training value, further research is needed to determine whether the device can support the training of moving target engagement skills. In addition, RC-specific TopGun training strategies need to be identified and developed in order to promote device usage in the field and ensure maximum payoff from training resource expenditures.

Difficulty in hitting moving targets under auxiliary sighting probably can be attributed in large part to the complexity of cognitive skill requirements. Without the laser range finder and associated computer adjustments operative under primary sighting, the gunner must mentally compute the appropriate azimuth and elevation values required to establish a correct point of aim. For moving targets, these mental computations are likely to be influenced by numerous target characteristics such as size, speed, and direction. In contrast, fewer target characteristics, e.g., distance, need to be considered in calculating a correct aiming point for stationary targets.

Given the relative difference in the number of factors that a gunner must consider when attempting to hit stationary versus moving targets, both the rapid development of stationary target transfer and the overall lack of moving target transfer found in the present research, can be understood. Thus, to increase the probability of achieving effective transfer on moving targets, future research should extend TopGun training trials beyond the number used here.

Lack of prior research findings to draw upon makes it difficult to estimate the optimum number of TopGun training trials to furnish on moving targets. Enough trials should be given to allow sufficient learning and transfer, yet the number of trials should be minimized to ensure efficient use of resources.

One possible systematic strategy for achieving both goals is to base the estimate of required training trials on the number of target characteristics varied during training. For example, if moving targets were varied in terms of size (small, large), distance (close, distant), speed (slow, fast) and direction (45, 90, and 180 degrees), then there would, in effect, be a total of 24 (i.e., 2 x 2 x 2 x 3) different types to engage. If, as suggested by the present research, little or no intertarget transfer occurs, and a minimum of 10 trials is necessary to master a particular target type, then it would take at least 240 training trials (i.e., 10 trials x 24 target types), instead of the 20-60 presented here, to promote measurable transfer from TopGun to COFT on moving targets under auxiliary sighting conditions. Over these trials, soldiers should demonstrate concurrent improvement in the perceptual-motor skills needed to manipulate gunner controls (i.e., response execution), as well as the cognitive skills needed to estimate correct point of aim (i.e., response selection).

Of course, the above strategy for estimating TopGun training trial requirements should be considered only a start. The final

strategy will also have to accommodate the level of perceptual-motor and cognitive skill proficiency brought to the training session by the soldier. For example, those who train on TopGun to sustain a certain skill proficiency level should require fewer trials than the number needed initially to attain that level (e.g., Mengelkoch, Adams, & Gainer, 1971).

Whether or not a suitable strategy for estimating trial requirements can be found, TopGun training invariably will require some multiple number of trials on different types of targets in order to be effective. If so, then how should these targets be presented over trials? At least two strategies are possible: blocked presentation where multiple trials are given on one target type (e.g., close, stationary) before presentation of another (e.g., distant, stationary), or random presentation where each trial contains a different type of target.

Each strategy has its own advantages. Blocked presentation tends to promote rapid acquisition, whereas random presentation tends to promote retention and transfer (Wells & Hagman, 1989). Thus, RC training should incorporate both strategies to leverage the advantages of each. That is, initial training trials should employ blocked presentation to bring soldiers up quickly to a reasonable level of proficiency. Thereafter, remaining trials should incorporate random presentation to ensure skill retention levels capable of supporting effective transfer even after prolonged intervals of no practice.

Unfortunately, whatever combination of strategies is used, tank gunnery training most likely will require a considerable number of trials to achieve desired proficiency levels. Devices, such as TopGun, should prove invaluable to the RC in helping to attain these levels under current live-fire range and ammunition constraints.

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